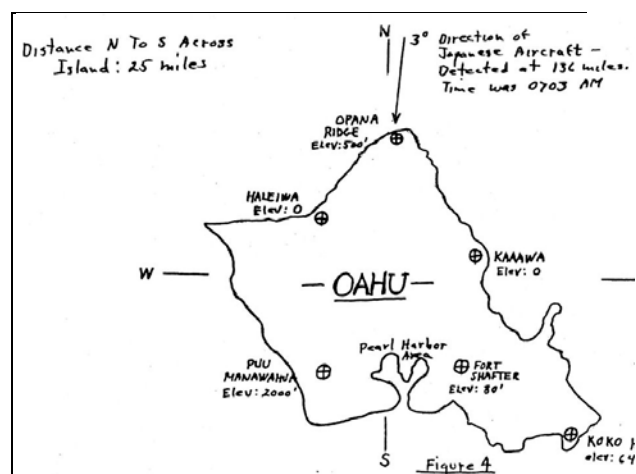


First Wartime Use of RADAR

By Floyd Jury, W3OLV, and George Gadbois, W3FEY

The first wartime use of RADAR by the United States military was on Dec. 7, 1941 when Japan attacked Pearl Harbor to destroy as much as possible of the Pacific Fleet. The attacking Japanese planes were tracked by a portable SCR-270B radar installed on Opana Ridge (Elev ~500') the preceding Thanksgiving Day. A total of six portable radar stations were installed at that time.



Oahu Radar Sites Dec. 7, 1941 J. Lockard

The operating schedule for the six radar stations was 04:00 to 07:00 local time. The Opana Ridge radar station was manned that day by 19 year old Private Joseph Lockard, of Williamsport and Private George Elliott of Chicago. Lockard was the more experienced operator and he was training Elliott.

There were no eating facilities at Opana. An Army truck was scheduled to pick them up at 07:00, but it was late so they kept the radar operating past 07:00 at Elliott's request for more training.

Lockard spotted the largest group of aircraft he had ever seen at 07:02. Lockard suspected an equipment malfunction, but after checking he decided the target was real. "By their calculations, a large flight of planes was 132 miles off Kahuku Point and approaching at a speed of three miles a minute.¹"

Elliott called the Fort Shafter information center at 07:20. The only officer still on duty was Lt. Kermit Tyler, a Pursuit Squadron officer, who had been assigned as a liaison officer the preceding Wednesday with very little instruction as to what he was supposed to do. The shift for the Signal Corps officer at Fort Shafter had ended at 07:00.

Lt. Tyler had heard rumors that a flight of B17s would be coming in from the northeast so he assumed that was the target even though the approach was from 3° east of north. Tyler told them to "forget it²". Tyler had no information on how to contact anyone with more experience for such an event.

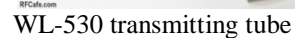
The breakfast truck arrived at 07:40 and the radar was shut down. Lockard and Elliott learned of the attack at breakfast and immediately went back to Opana and put the radar back on the air and tracked Japanese flights for the rest of the day including their return flights to the Japanese aircraft carriers north of Oahu.

"Within a half hour after the first bombs fell in Hawaii, the Signal Aircraft Warning Company, Hawaii, had manned all six radar stations and the information center. About 10:00 a bomb blast cut the telephone wires leading from the Waianae station radar to

1 "The Signal Corps: The Test", Pg 4

2 "The Signal Corps: The Test", Pg 5

The SCR-270 transmitter used two Westinghouse WL530 water cooled transmitting tubes rated to 120MHz with 8KW plate dissipation.



Microwave Museum



VT701A Pulse Modulator Floyd Jury collection



WL-531, VT-141 High Voltage Rectifier Floyd Jury collection

Radar Receiver Design

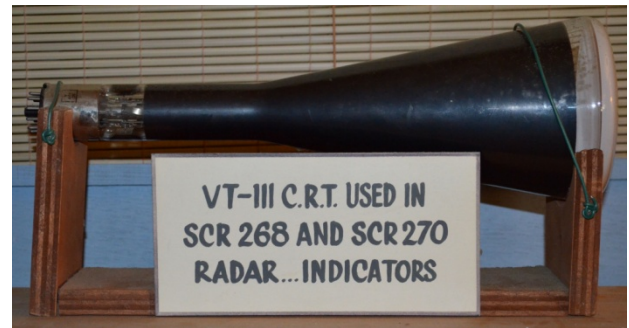
RCA Labs in Camden, New Jersey did the receiver design work. Dr. Irving Wolff was assigned to the project. Production was probably done at the RCA Camden plant. RCA Labs moved to Princeton, NJ in 1942.

The superheterodyne receiver used an RCA 1630 (A-5588)⁴ VT-128 UHF Orbital Beam Hexode as a high gain VHF amplifier. It was later replaced by a conversion kit with 6J4s because of poor life of the secondary emitters in the VT128.



RCA 1630 (A-5588) VT128 Tube Collectors Association

The radar display was before the PPI displays we all see on TV weather radar. It was much simpler and required more operator skill. It is described as an 'A' scope with the transmit pulse on the left and the return signal displayed as a blip above the baseline scan to the right. Distance was determined by the displacement of the return blip from the transmit pulse.



Radar display tube

Floyd Jury collection

Azimuth was read with binoculars from the calibrations on the rotating base of the antenna.



SCR-270B antenna model by Floyd Jury, W3OLV

The antenna used at Opana was a 9H x 4W dipole plus reflector array. There does not appear to be any extant photo of the Opana installation on Dec. 7, 1941. The radars were considered top secret at the time. There are photos of an SCR-270B installation in New Guinea similar to the Opana installation. See photo next page.

⁴ "Tube Collector", Vol. 15, Number 1, February 2013. "Weird Tube of the Month: The RCA 1630", pp 14-16



Morobe, New Guinea, September 1943

The Opana antenna was later turned to a horizontal position to improve azimuth resolution. The antenna array was probably changed to a 4H x 8W dipole configuration at that time. There is no evidence of vertically polarized antennas ever being used for the SCR-270 radars.



L-R Floyd Jury, Joseph Lockard circa 1988

Joseph Lockard reported to Floyd Jury in their interview that radar operators discovered they could track China Clipper flights out of Honolulu routinely beyond the 150 mile design range of the SCR-270B radar and sometimes beyond 300 miles. From what we know about 2m tropospheric propagation today, this is not a surprising result. It takes a lot of operator skill and a large target to recognize a return from an earlier transmit pulse. Knowing the course of the Clipper was the giveaway.

Whereas the SCR-270 radar was ready for wartime use on December 7, 1941, the command and control organization required to make effective use of the radar data was not. It took awhile for the full capability of radar to be understood and used effectively.

Admiral Isoroku Yamamoto knew what he was doing when he planned the Pearl Harbor attack for Sunday morning. He knew that it was a day off for the more senior personnel

at all levels, thus leaving less experienced personnel to handle the initial response to the attack. That paid off well for the Japanese attackers.

The SCR-268 and SCR-270 radars stayed in service throughout WWII. The Opana Ridge radar was given to the University of Saskatchewan after WWII for aurora research and later to the National Electronics Museum.

Microwave radio and radars were developed rapidly during the war. Much of the work was done at the MIT Radiation Lab. After the war, their work was published as the Rad Lab series and they remain as valuable reference sources for VHF to microwaves.

Joseph Lockard passed away Nov. 2, 2012. His obituary was published in the Harrisburg Patriot News. He lived in Lower Paxton Twp at the time.

References:

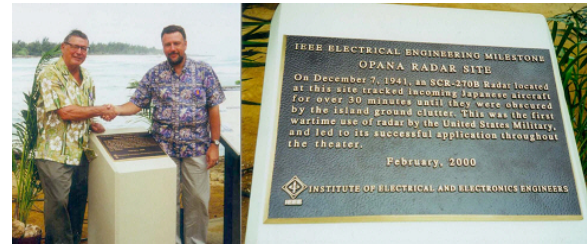
Floyd Jury interview with Joseph Lockard circa 1988. This interview started at lunch and lasted over two hours.

“A History of the U.S. Signal Corps”, Editors of the Army Times, The Army Times Publishing Co., G. P. Putnam’s Sons, New York, 1961

“The Signal Corps: The Test”, Thompson, Harris, Oakes, and Terrett, Office of the Chief of Military History, Department of the Army, Washington, D.C., 1957, U. S. Government Printing Office

“The Signal Corps: The Emergency”, Terrett, Office of the Chief of Military History, Department of the Army, Washington, D.C., 1956, U. S. Government Printing Office

OPANA RADAR SITE DESIGNATED AS AN IEEE HISTORICAL MILESTONE



IEEE web site photo

National Electronics Museum

National Electronics Museum, Inc. 1745
West Nursery Road Linthicum, Maryland

Shadek-Fackenthal Library, Franklin & Marshall College, Lancaster, PA. This library has the Signal Corps series of WWII histories. The collection is in a repository of U.S Government documents. There are many of these repositories around the country. You should be able to find one near you.

David Sarnoff Library Dr. Alex Magoun
RCA historian

Tube Collectors Association Ludwell
Sibley, KB2EVN, President and Editor

Hagley Museum & Library. Greenville, DE,
(298 Buck Road, Wilmington, Delaware
for GPS.) Sarnoff Library collection,
notebooks and papers.

The Sarnoff Collection at the College of
New Jersey Contains museum samples
of RCA developed hardware.